BIOCHEMISTRY & MICROBIOLOGY

Associate Professor, Microbiology & Head of Department
J Dames, PhD(Wits)
Associate Professor& Head of Microbiology
C Knox, PhD(Wits)
Professor, Microbiology & SARChi Chair in Marine Natural Products
RA Dorrington, BSc Agric(Stell), PhD(UCT)
Lecturer, Microbiology
GL Abrahams
Senior Lecturer & Head of Biochemistry
BS Wilhelmi, B.Tech:Ed(TWR), PhD(Rhodes)
Professor, Biochemistry
BI Pletschke, PhD(UPE)
Associate Professor, Biochemistry
H Hoppe, PhD(UP)
Associate Professor, Biochemistry & SARChi Chair in Molecular and Cellular Biology of the Eukaryotic Stress Response
AL Edkins, MSc(RU), MSc Forensic Sci (KCL), PhD(Glasgow)
Associate Professor, Bioinformatics
O Tastan Bishop, MSc(Bogazici University, Turkey), PhD(Max Planck Inst., Germany)
Emeritus Professor
CG Whiteley, PhD(Natal), MRSC, CChem
Emeritus Associate Professor
DA Hendry, PhD(UCT)
Visiting Professor
GL Blatch, BSc(Hons)(Natal), PhD(UCT), FRSSAf
K McPhail BSc (Hons)(RU), PhD(RU)
D Lang MSc, PhD(University of Konstanz, Germany)

The Department offers courses in Biochemistry and Microbiology.

See the Departmental Web Page http://www.ru.ac.za/bm/ for further details, particularly on the contents of courses.

Introductory Molecular Biology

Introductory Molecular Biology (IMB) is a two-semester subject offered at the second year level to students not majoring in either Biochemistry or Microbiology who require a basic understanding in biochemistry and molecular biology for application in other biological sciences, law, journalism, pharmacy, computer science and education. The subject is comprised of two semester courses offered in Biochemistry and Microbiology, namely IMB 201 (same as BCH 201) and IMB 202 (same as MIC 202). Credit may be obtained in each course separately and, in addition, an aggregate mark of at least 50% will be deemed to be equivalent to a two-credit course IMB 2, provided that a candidate obtains the required sub-minimum (40%) in each component. No supplementary examinations will be offered for either course. Practical reports, essays and class tests collectively comprise the class mark, which forms part of the final mark.

Credit in Chemistry (CHE 1) is required before a student may register for IMB 2. A sub-minimum of 40% in IMB 201 is required for registration in IMB 202. Students unable to complete IMB 201 and IMB 202 in the same calendar year will be required to pass both courses to obtain a credit in IMB 2. Credit in IMB 2 will not enable registration for either BCH3 or MIC 3.

BIOCHEMISTRY

Biochemistry (BCH) is a four-semester subject which may be taken as a major subject for the degrees of BSc, BCom and BJourn.

To major in Biochemistry, a candidate is required to obtain credit in the following courses: CHE 1; BCH 2; BCH 3: See Rule S.23. In addition, students wishing to major in Biochemistry are encouraged to obtain credit for CEL 101; MIC 202.

Students who aim to major in Biochemistry and progress to postgraduate studies in computational biology, genomics, protein structure and function and biotechnology are encouraged to register for advanced courses in one or more of Microbiology, Computer Science, Chemistry or Mathematics.

Second-year level courses in Biochemistry

There are two second-year courses in Biochemistry. BCH 201 is held in the first semester and BCH 202 in the second semester. Credit may be obtained in each course separately and, in addition, an aggregate mark of at least 50% will be deemed to be equivalent

to a two-credit course BCH 2, provided that a candidate obtains the required sub-minimum (40%) in each component. No supplementary examinations will be offered for either course. Practical reports, essays and class tests collectively comprise the class mark, which forms part of the final mark.

Credit in Chemistry (CHE 1) is required before a student may register for BCH 201 or BCH 202. A sub-minimum of 40% in BCH 201 is required before a student may register for BCH 202. In addition, a credit in MIC 202 is strongly encouraged for students wishing to major in Biochemistry.

BCH 201
(One theory paper and a practical examination) **Building Blocks**: Aqueous biochemistry & buffers; building blocks in biochemistry; amino acids & proteins; nucleotides, DNA & RNA; carbohydrates; lipids & membranes; vitamins, coenzymes & enzymes. **Bioenergetics & Metabolism**: Enzyme kinetics, specificity & regulation; bioenergetics & thermodynamics; catabolism & catabolic pathways; substrate and oxidative phosphorylation.

BCH 202
(One theory paper and a practical examination) **Biochemical Techniques**: This course is taught in the context of protein purification and analysis and includes: protein purification strategies; cell disruption and centrifugation; chromatography; spectroscopy; electrophoresis; immunological techniques and protein-protein interactions.

Third-year level courses in Biochemistry

There are two third-year courses in Biochemistry. BCH 301 is normally held in the first semester and BCH 302 in the second semester but the department reserves the right to offer them in either semester subject to timetable constraints. Credit may be obtained in each course separately and, in addition, an aggregate mark of at least 50% will be deemed to be equivalent to a two-credit course BCH 3, provided that a candidate obtains the required sub-minimum (40%) in each component. No supplementary examinations will be offered for either course. Practical reports, essays and class tests collectively comprise the class mark, which forms part of the final mark.

Credit in Biochemistry (BCH 2) is required before a student may register for BCH 301 or BCH 302. A sub-minimum of 40% in the first semester is required before a student may register for the second semester. In addition, a credit in MIC 202 is strongly encouraged for students wishing to major in Biochemistry.

BCH 301
(One theory paper and a practical examination) **Biochemistry of Information Flow**: The structure of chromosomes and plasmids; DNA replication and repair; transcription and regulation of gene expression; protein synthesis, transport and degradation.

Medical biochemistry: Signal transduction in the context of hormones and neurotransmission; metabolism of biomolecules.

BCH 302
(One theory paper and a practical poster and presentation examination)

Enzyme Kinetics and Mechanisms: Enzyme mechanisms; advanced enzyme kinetics; advanced theory and application of computational methods and tools for the visualization and modeling of enzymes.

Protein trafficking and organelle formation: The formation of eukaryotic cell organelles and their protein compositions.

Bioinformatics: Introduction to bioinformatics with case studies.

Biochemistry Honours

The course consists of course-work modules and lectures on selected advanced topics such as drug metabolism, drug identification, forensic biochemistry, antibiotics, biomedical biochemistry, receptors, hormones, structure & function of biomacromolecules, protein folding, protein purification and biotechnology, protein engineering, advanced enzymology, applied enzymology & immobilized enzymes; bioinformatics, proteomics, seminars, a literature review, essays and a research project.

This course is assessed through written tests, continual assessment of a research project, and examinations.

MICROBIOLOGY

Microbiology (MIC) is a four-semester subject which may be taken as a major subject for the degrees of BSc, BCom and BJourn.

To major in Microbiology, a candidate is required to obtain credit in the following courses: CHE 1; CEL 101 (or an aggregate pass in ZOO 1 or BOT 1); MIC 2; MIC 3. See Rule S.23. In addition, students wishing to major in Microbiology are strongly encouraged to obtain credit for BCH 201.

Students who aim to major in Microbiology and progress to postgraduate studies in computational biology or genomics are encouraged to register for advanced courses in one or more of Biochemistry, Computer Science, Chemistry or Mathematics.

Second-year level courses in Microbiology

There are two second-year courses in Microbiology. MIC 201 is held in the first semester and MIC 202 in the second semester. Credit may be obtained in each course separately and, in addition, an aggregate mark of at least 50% will be deemed to be equivalent to a two-credit course, MIC 2, provided that a candidate obtains the required sub-minimum (40%) in each component. No supplementary examinations will be offered for either course. Practical reports, tutorials and class tests collectively comprise the class mark, which forms part of the final mark.

Credit in Chemistry (CHE 1) and in Cell Biology (CEL 101) (or an aggregated credit in either Botany (BOT 1) or Zoology (ZOO 1) is required before a student may register for MIC 201. A sub-minimum of 40% in MIC 201 is required for registration in MIC 202. In addition, a credit in BCH 201 is strongly recommended for students wishing to major in Microbiology.
The courses comprise of the following modules, not necessarily in the given position, each module lasting about three weeks.

MIC 201
(One theory paper and a practical examination)
Microbes and their environment:
Introductory Microbiology (classification, growth, assay and control of microorganisms). Organization and replication of microbes (microbial structure; cellular organization and modes of replication of yeast, bacteria, fungi and viruses). Pathogenic microbes. Microbial interactions and ecosystem services (nutrient cycling and metabolism) . The course includes practical experience in the isolation and culture of microbes, their identification and interaction with each other and the environment and a field trip.

MIC 202
(One theory paper and a practical examination)
Molecular Biology and Genetics:
Introductory molecular biology (the structure of nucleic acids and proteins; the flow of genetic information; mutagenesis): Basic bacterial genetics (bacterial conjugation, transformation and transduction; plasmids; bacteriophages): Procaryote gene regulation (plasmid replication and host range; transposable elements; regulation of gene expression); Recombinant DNA Technology. The course will include a practical introduction to basic molecular techniques (DNA isolation and characterization, bacterial transformation gene regulation studies).

Third-year level courses in Microbiology

There are two third-year courses in Microbiology. MIC 301 is held in the first semester and MIC 302 in the second semester. Credit may be obtained in each course separately and, in addition, an aggregate mark of at least 50% will be deemed to be equivalent to a two-credit course MIC 3, provided that a candidate obtains the required sub-minimum (40%) in each component. No supplementary examinations will be offered for either course. Practical reports, tutorials and class tests collectively comprise the class mark, which forms part of the final mark.

Credit in Microbiology (MIC 2) is required before a student may register for MIC 301 or MIC 302. A sub-minimum of 40% in the first semester is required before a student may register for the second semester. In addition, a credit in BCH 201 is strongly recommended for students wishing to major in Microbiology. The courses comprise of the following modules, not necessarily in the given position, each module lasting about three weeks:

MIC 301
(One theory paper and a practical examination)
Eukaryote Molecular Biology and Advanced Virology: Eukaryote cell biology (structure and function of the cellular organelles; protein sorting and trafficking). Eukaryote molecular genetics (genome structure and organisation, the eukaryotic gene, the flow of information, transcriptional and translational regulation of gene expression; the cell cycle and apoptosis): Concepts in Immunology; Biology of HIV or other selected virus. The practical component of this course focuses on recombinant DNA techniques (DNA cloning, genetic manipulation of bacterial cells) and purification of viruses.

MIC 302
(One theory paper and a practical examination)
Applied microbiology: Exploiting microorganisms for industrial and commercial purposes. Topics covered include microbial ecology; biological control; agriculturally important microbes; metabolic engineering; microbial growth kinetics; batch and continuous culture; primary and secondary metabolism; antibiotic production; amino acid production; beer brewing, biodegradation and biosensors; stem cell biology; host pathogen interactions. The course includes practical experience in isolating and characterising microorganisms from specific environments , and the fermentation of alcoholic beverages. A field trip to local industries is included.

Microbiology Honours
(Coursework and Comprehension examinations)
The course consists of modules on mammalian cell culture techniques and microscopy; plant soil microbe interactions; host pathogen interactions; microbial ecology and marine biotechnology. The course is assessed through essays, tutorials, journal clubs and seminars with written tests. Each candidate is required to submit a report on practical work done on a specific project in the areas of molecular virology, mycology, mycorrhizal fungi, cellular microbiology or microbial genetics during the course, and this together with all assessment marks will be considered part of the final examination.

BIOINFORMATICS

Bioinformatics is offered at the postgraduate level. A joint Honours programme is offered between the Department and the Departments of Computer Science, Mathematics and Statistics. Candidates for this programme must have completed a BSc structured as follows:

CHE 1 CSC 1 MAT 1 STA 1 *CEL 101*
BCH 2 CSC 2 MAM 2 or MST 2
BCH 3 CSC 3 or MAT 3 or MAM 3 or MST 3

MSc in Bioinformatics and Computational Molecular Biology

General background:
Bioinformatics and computational molecular biology is the systematic development and application of information technologies and data mining techniques for analysing biological data obtained by experiments, modelling, database searching and instrumentation to make novel observations and predictions about biological function. This course will be taught in an interdisciplinary manner and focusing on the interface between the computational sciences and the biological, physical and chemical sciences. Graduates who complete this course will be skilled in the assimilation of biological information through the use and development of computational tools for a range of applications including simple pattern recognition, molecular modelling for the prediction of structure and function, gene discovery and drug target discovery, the analysis of phylogenetic relationships, whole genome analysis and the comparison of genetic organization.

Eligibility:
Candidates who hold a BSc Honours degree with subjects from the life sciences (especially Biochemistry, Genetics and Microbiology), Chemistry, Computer Science, Mathematics, Physics and Statistics and who have basic computer literacy, may apply for admission.

Course structure:
The Master's programme will be offered over 12 months and incorporates a number of course work modules and a research project. The course work modules will involve an integration of formal

lectures, self-learning computer-based tutorials and practicals. In addition, problem solving tutorials would be designed to guide the student through current information-based problems and involve the assimilation and reduction of biological information. A number of the tutorials and practical components will be assessed and contribute towards a course work year mark. The examination of the course work component would be through oral and open-book theory examinations. The course work component will be externally examined.

A number of research projects will be offered, depending on the interests of the academic staff associated with the program.

The projects will be assessed by seminar presentations of the proposed and final work, and as a written thesis that will be externally examined.

Course work modules:
The course work consists of modules and lectures on introductory and advanced topics including computer operating systems and programming (e.g. Linux, Python and MatLab), basic statistics, databases, basic and advanced genomics, comparative genomics, metagenomics and structural bioinformatics (e.g. homology modelling, protein-ligand, protein-protein interactions, protein engineering).

Assessment:
The course work modules will be assessed by internal grading of tutorials and practicals, and by internal and external grading of work assignments, mini-projects and examinations. The project report and thesis will be graded internally and externally. The overall course work mark and the research component mark will each contribute equally to the final mark. Successful completion of the course will be subject to a final mark of at least 50%, provided that a candidate obtains at least 50% for the course work, with a sub-minimum of at least 40% from each module (with at least 40% in the examination) and at least 50% for the project report, project presentations and thesis.

Master's and Doctoral degrees
Suitably qualified students are encouraged to proceed to the research degrees of MSc and PhD under the direction of the staff of the Department. Requirements for the MSc and PhD degrees are given in the General Rules.